Syllabus

Savitribai Phule Pune University

Faculty of Engineering

Fourth Year Production Sandwich Engineering

(Course 2015)

(with effect from June 2018)

Savitribai Phule Pune University, Pune
Syllabus for Fourth Year Production Sandwich Engineering
(2015 Course)
(With effect from Academic Year 2018-19)

Semester- I

Course Code	Course	Teaching Scheme (Hrs/week)			Examination Scheme						Credit	
		Theory	Practical	Tutorial	Paper		TW	OR	PR	Total	TH/TW/TUT	PR/OR
					In-Sem	End-Sem						
411121	Operations Research & Management	4	_	_	30	70	_	_	_	100	4	_
411122	Mechatronics & Robotics	4	-	-	30	70	_	_	_	100	4	_
411123	Advanced Production Technology	3	-	-	30	70	_	_	_	100	3	_
411124	Elective I	3	_	_	30	70	_	_	_	100	3	_
411125	Elective II	3	_	_	30	70	_	_	_	100	3	_
411126	Operations Research & Management Lab	_	2	_	_	_	50	-	_	50	_	1
411127	Mechatronics & Robotics Lab	_	2	_	_	_	_	50	_	50	_	1
411128	Advanced Production Technology Lab	_	2	_	_	_	_	50	_	50	_	1
411129	Elective I Lab	_	2	_	_	_	50	_	_	50	_	1
411130	Computer Applications in Production Engineering Practical	_	2	_	_	_	50	_	_	50	_	1
											17	5
Total		**17**	**10**	**-**	**150**	**350**	**100**	**150**		**750**	**22**	

Elective I

a) Machine tool design

b) Automobile Engineering & Manufacturing

c) Computer Integrated Manufacturing and Industrial Robotics

d) Plastic Engineering

Elective II

a) Ergonomics and Human Factors in Engineering

b) Materials Management & Logistics

c) Financial Management & Cost Control

d) Product Development

Abbreviations:
TW: Term Work, TH: Theory, OR: Oral, TUT: Tutorial, PR: Practical

Savitribai Phule Pune University, Pune
Syllabus for Fourth Year Production Sandwich Engineering
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Semester- II

Course Code	Course	Teaching Scheme (Hrs/week)			Examination Scheme						Credit	
					Paper							
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	OR	PR	Total	TH/TW/TUT	PR/OR
41131	Industrial In-plant Training for 6 months (2 contact hrs. Per student per week) @	_	_	_	_	_	150 *	100 #	_	250	_	12
41132	Project	-	-	-	-	-	100*	100#	-	200	-	4
41134	Elective III (Self Study) $	_	_	_	30	70	_	_	_	100	4	_
41135	Elective III Lab	_	_	_	_	_	50	_	_	50		1
41133	Technical Paper Presentation	-	_	_	_	_	25*	25*	_	50	_	1
											4	18
Total						225	225	70	650	30	**22**	

Elective III

a) Supply Chain Management.

b) Plant Engineering & Maintenance.

c) Industrial Relations & Human Resource Management

d) Marketing Management

- Oral based on TW by one internal guide & one external examiner from industry

* - Exams to be conducted in End of Semester after successful completion of Industrial Training and student had procured completion of 6 months Industrial Inplant Training completion certificate from concerned industry.

$ - Students should study this subject during training & contact college guide for guidance.

@- The contact hours are provided for supervision of students under training and for providing guidance regarding the seminar/theory subject to be studied during the training.

411121: OPERATIONS RESEARCH AND MANAGEMENT

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 04 hours / week	Theroy:04	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Engineering Mathematics-III, Production Management-I &II

Course objectives:

1. To introduce the students how to use variables for formulating complex mathematical models in business management, industrial engineering and transportation engineering.
2. To provide the students with opportunity of using various software package for solving linear programming and other models
3. To introduce the students to use basic methodology for transportation problems.
4. To introduce the students to the basic concepts of queuing phenomenon.
5. To introduce the students the concept of system simulation..
6. To familiarize students with the basic concepts of project management.

Outcomes:

After learning this subject, the student will:

1. Know principles of construction of mathematical models of conflicting situations and mathematical analysis methods of operations research;
2. Be able to choose rational options in practical decision-making problems using standard mathematical models of operations research;
3. Have skills in analysis of operations research objectives, mathematical methods and computer systems.
4. Use mathematical software to solve the proposed models.
5. Solve inventory related problems with simulation technique.
6. Able to handle management of projects.

Unit I: Linear programming [8]

Definition of Operations Research: Scope & objectives, formulation of problem, graphical method, simplex methods for maximization and minimization problems.

Unit II: Advanced linear programming [8]

Degeneracy in L.P., duality in L. P.; Sensitivity analysis, Introduction to Interior Point Algorithm and Integer Programming & non-linear programming

Unit III: Transportation and assignment problem [8]

Structure, industrial and business application Transportation problems- use of various methods for solving transportation problem, degeneracy and its solution, transshipment problem. Assignment problem solutions of various types of problems, travelling salesman Problem.

Unit IV: Queuing theory **[8]**

Operating characteristics, Poisson single and multi channel queuing system M/M/1: ¥/ FCFS, MCSR. Games Theory: Introduction, two -person zero sum game, minimax and maximin principle, saddle point, methods for solving game problems with mixed strategies, Graphical and iterative methods.

Unit V: Simulation and Replacement models **[8]**

Introduction, application, Monte Carlo simulation of queuing system, classical inventory system & simulation, capital budgeting, new product planning etc.

Replacement models

Replacement of capital equipments that deteriorates with time, time value of money (a) remains same (b) changes with constant rates during period. Equipment renewal policy, group and individual replacement. Payback Period and IRR Method.

Unit VI: Project Management **[8]**

Construction of networks, critical paths, forward and backward pass, floats and their significance, crashing for optimum duration and the cost, resource allocation and leveling, Time estimates, construction of networks, probability of completing projects by given date.

Text Books:

1. S. D. Sharma, "*Operations Research*", Kedarnath Ramnath and company Publications.
2. P. K. Gupta, D. S. Hira, "*Operations Research*", S Chand and Co. Ltd., ISBN 81-219- 0281-9.
3. H. A Taha., "*Operations Research* An introduction", Prentice Hall Pvt. Ltd., ISBN 81-203-1222-8.

Reference Books:

1. F. S. Hillier, G. J Lieberman, "*Introduction to Operations Research*", Tata McGraw-Hill, ISBN 0-07-047387-0.
2. H. M. Wagner, "*Principles of Operations Research*", Prentice-Hall India, ISBN 81-203- 0162-5.
4. A. Ravindran, "*Operations Research*", Tata McGraw-Hill.
5. S. K. Basu, D. K. Pal, H. Bagchi, "*Operations Research for Engineers*", Oxford and IBH Publishing Co. Pvt. Ltd., ISBN 81-204-1251-6.
6. R. Panneerselvam, "*Operations Research*", Prentice Hall of India Ltd., ISBN 81-203-1923-0.

411122: MECHATRONICS AND ROBOTICS

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 04 hours / week	Theroy: 04	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Basic Electrical Engineering; Basic Electronics Engineering; Electrical Technology

Course Objectives:

1. To make aware students about applications of Mechatronics system to automate manufacturing processes.
2. To provide the knowledge of amplifiers used in electrical circuits, measurement system terminology.
3. Understanding Basics of Analog Signal Processing and the Design Analysis of Operational Amplifiers.
4. Understanding Basics of Digital Devices and Integrated Circuits.
5. Understanding Basic & Programming of PLC.
6. Understanding Sensors and Actuators used in Mechatronics systems.
7. Study of Robotics Terminology, Anatomy and Applications.

Outcomes:

1. Be able to integrate mechanical, electronics, control and computer engineering in the design of Control systems.
2. Student able to understand digital system architecture including microprocessor & controller.
3. Student able to understand interfacing with Input and Output devices.
4. Be able to understand the concept of Process Control using Programmable Logic Controller and various types of Sensors.
5. Be able to understand electrical actuators, and various controlling modes such as PID controller
6. Be able to understand professional and ethical responsibility and be aware of the impact of their designs on robotics/human-kind structure and the environment

Unit I Control System (8)

Introduction: Mechatronics system, Elements of Mechatronics system.Elements of control system, Types of control system, Microprocessors based controllers.

System Response: Amplitude linearity, phase linearity, distortion of signals, dynamic characteristics of Systems, zero order systems, first order systems.

Signal Processing: Operational amplifiers, requirement for protection and filtering, comparators and Rheostat, Bridge, ADC-DAC converter, multiplexes, Data acquisition using DAQ boards, principle of digital signal Processing, principle of pulse modulation.

Unit II: Digital System Architectures (8)

Digital representations, combination logic & logic classes, timing diagrams, sequential logic, TTL and CMOS integrated circuits, integrated system circuit design.

Microprocessors

Basic structure of microcomputer, microprocessor and micro controller, programs using flow Charts or Pseudo Codes.

Unit III: Input output Systems (8)

Interfacing, Interfacing requirements, interface adapters, buffers, Tri-state buffers, hand shaking and Serial interfacing. Parallel interfacing, Function of synchronous communication, Networks.

Unit IV: Programmable logic controllers (8)

Basic structure of PLC, program of PLC, logic functions, latching and sequencing, Develop programs involving timers, internal relays, counters, shift registers. Sensors and Transducers, Performance or commonly used sensors, sensors used in measurements of Displacements, position proximity, velocity and motion, force, fluid pressure, liquid flow, Liquid level, temperature, stress and strain, vibration and acceleration, semi conductor, sensors and micro chemical devices.

Unit V: Actuators (8)

Electrical actuator systems: - solenoids. relays, solid state switches tyristors, tripolar transducers, Solenoid actuator system, DC Motors, AC motors and steppers. Hydraulic actuator systems: hydraulic valves, hydraulic actuators. Pneumatic actuators systems: sequential control system involving valves and cylinders, process control valves.

Control Actions: On-Off, proportional, proportional +integral, P+D. proportional + integral+ derivative control actions and its applications. Mechanical actuator systems Involving linkages, gears, ratchet and pawl, belt and chain drives and bearings.

Unit VI: Basic concepts in Robotics (8)

Automaton: Automaton and its type,

Robotics: Basic of Robotics, robot anatomy, basic structure of robots, resolutions, accuracy and repeatability, applications of robots in manufacturing. Robot Programming. Classification structure of **Robotic System**: Control loops of robotic systems, the manipulators, the wrist motion and grippers and its types. Vision system

Text Books:

1. B. H. Histard, D. G. Alciator, "*Introduction to Mechatronics and Measurement Systems*", Tata McGraw Hill Publication, ISBN 0-07-052970-8.
2. B. C. Kuo, "*Automatic Control Systems"*, prentice Hall, ISBN 0-87-692480-1.
3. D. Necsvlescu, "*Mechatronics*", Pearson Education Pub. India Pvt. Ltd., ISBN 87- 78086726-X
4. C. D. Johnson, "*Process Control Instrumentation Technology*", Prentice Hall of India Pvt. Ltd., New Delhi.
5. W. Bolton, "*Mechatronics"*, Pearson Education Asia New Delhi, ISBN 81-7808-3396.

References Books:

1) D. Shetty, R. Kolk, "*Mechatronics System Design*", Thomson Books Pub., ISBN98-1240062-2.
2) B H Histand, D G Alciatore, "*Introduction to Mechatronics and Measurement Systems"*
3) Gopal, "*Control systems*", Tata McGraw hill
4) Ramesh. Gaonkar, "*Microprocessor*", Penram International Pub. Pvt. Ltd., ISBN 81-900828-09.

411123 ADVANCED PRODUCTION TECHNOLOGY

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Prerequisites: Basic manufacturing processes, Basics of Fluid Mechanics, Theory of machine and mechanism, Strength of material, Design of machine elements

Course Objectives:

1. Study of different types of Hydraulic Pneumatic components, circuits for automated systems
2. Study and Design and develop different hydraulic and pneumatic circuits
3. Study of development in factory Automation system like , AGVS, FMS, feeder systems
4. students will be Able to describe and predict the methodology of group Technology and Rapid prototyping methods
5. Study of concept of advance machining. Like Dry, Near dry hard part machining
6. Study concept of Nano Tech, Nano-manufacturing and fine finishing process

Course Outcomes:

1. Students will select, demonstrate different types of Hydraulic Pneumatic components, circuits for automated systems
2. Design and develop different hydraulic and pneumatic circuits
3. Student will illustrate develop factory Automation system like , AGVS, FMS,feeder systems
4. Student will be able to apply concept Group Technology and Rapid Protyping Technique
5. Student will be able to apply concept of advance machining. Like Dry, Near dry hard part machining
6. Students will be able to apply concept of Nano Tech, Nano-manufacturing and fine finishing process

Unit I Hydraulics and Pneumatics Systems **[7]**

Principles of hydraulics; hydraulic fluids; filtration technology; hydraulic pumps valves and Actuators; hydraulic servo mechanism; proportional valves; selection of standard Components; Operational principles and application, air compressors; pneumatic cylinders &air motors;.

Unit II: Design of Hydraulic & Pneumatic Circuits for automation **[7]**

Basic hydraulic circuits such as regenerative circuits; sequencing circuit; meter in & meter out circuit; standards in circuit diagram representation; power pack design layout; design of pumps; reservoir, accumulators and intensifiers; pneumatic circuit design, Design of Pneumatic circuits;

Unit III: Factory Automation **[7]**

Transfer systems-Continuous, intermittent, Indexing mechanisms; vibratory bowl feeders, on-vibratory feeders, hopper feeders, rotary disc feeder, centrifugal, revolving feeder,; assembly systems, automated assembly, design for automated assembly, automated work piece Handling synchronous and non-synchronous material transfer; industrial robots, Automated Guided Vehicles; Automated factory,, Automated warehouse

Unit IV

Computer Integrated Manufacturing (CIM) **[7]**

Computer application in manufacturing automation; computer aided inspection and quality control. Computer integrated production management system;.; manufacturing resource planning; enterprise Introduction to Rapid Prototyping Group Technology: Part families part classification and coding; Cell formation techniques production flow analysis machine cell Design; Cellular Manufacturing

Unit V: Advanced Machining Process **[7]**

High Speed Machining Definition and physical aspects of high speed machining; Machining of monolithic parts, Basic Applications of HSM Technology; Dry and Semi-Dry Machining; Dry machine tools and equipments; Dry machining operations, Near Dry Machining System; Near Dry Machine tools and Machining Operations; Hard Part Machining Definition and Basic features of hard-part machining; Physical aspects and applications of Hard Part Machining; Surface finish produced by HPM;

Unit VI: Nano Technology &Nano manufacturing **[7]**

Basic aspects of Nano-Manufacturing; Ultra-precision machines and Nano-scale, Machining Operations; Examples of Nano-Products; Introduction to Nano Metrology; Fine Finishing Process; Abrasive Flow Machining (AFM); Magnetic Abrasive Finishing(MAF); Magnetic Float Polishing (MFP);

Text Books:

1. Peter Rohner, "*Industrial hydraulic control*"John Willey & Son (Austrillia) Ltd,ISBN0471334987
2. Mikell P Groover, "*Automation, Production System and Computer Integrated Manufacturing*", Prentice Hall Publications, ISBN 81-203-0618-X.
3. S. R. Mujumdar, "*Pneumatic system*", Tata McGraw Hill 2010 Edition, ,ISBN0074602314
4. Gopal, "*Control systems Engineering*", Willey Eastern Ltd., ISBN 0-85226-605-7.
5. P.Radhakrishanan, S. Subramanium, V. Raju, "*CAD /CAM / CIM",* New Age International Pvt. Ltd. New Delhi, ISBN 81-224-1248-3

Reference Books:

1. HMT Mechatronics, HMT, ISBN 0-07-462147-5..
2. Vickers manual on hydraulics

411124 (a): ELECTIVE I: MACHINE TOOL DESIGN

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Machine Tool Operations, Mechanics of Materials and Design of Machine Elements, Kinematics of Manufacturing Machines.

Course objectives:

1. An ability to apply knowledge of Machine tool Design.
2. An ability to identify & solve engineering problems.
3. An ability to identify, conduct experiment as well as analyze the data.
4. An ability to design a system, component to meet the desired needs of subject to constraints.
5. Proficiency in process, assembly and product engineering:-Understand the design of machine tool design.
6. Proficiency in manufacturing. Competitiveness:-understanding the creation of competitive advantage through manufacturing planning, strategy & control of Machine tool design.
7. Proficiency in machine tool design: understanding the analysis of machine tool engineering.

Course Outcomes:

After learning this subject, the student will be able do:

1. Design multi-stage gear box for machine tool applications
2. Design structures and elements of machine tools such as bearings, powers crews, guideways etc.
3. Perform the analysis of vibration and dynamic characteristics of machine tools
4. Design special purpose machine tools

Unit I: Drives **(7)**

Design considerations for drives based on continuous and intermittent requirement of power, Types and selection of motor for the drive, Regulation and range of speed based on preferred number series, geometric progression. Design of speed gear box for spindle drive and feed gear box.Stepless drives: Design considerations of Stepless drives, electromechanical system of regulation, friction, and ball variators, PIV drive, Epicyclic drive, principle of self locking.

Unit II: Design of Machine Tool Structures **(7)**

Analysis of forces on machine tool structure, static & dynamic stiffness. Design of beds, columns, housings, bases and tables.

Unit III: Design of Guideways & Power Screws

Functions & types of guideways, design criteria & calculation for slideways, design of hydrodynamic, hydrostatic and aerostatic slideways, Stick-Slip motion in slideways. Design of power screws: Distribution of load & rigidity analysis.

Unit IV: Design of Spindles & Spindle Supports **(7)**

Design of spindle and spindle support using deflection and rigidity analysis, analysis of antifriction bearings,

preloading of antifriction bearing.

Unit V: Dynamics of machine tools (7)

Dynamic characteristic of the cutting process, Stability analysis, vibrations of machine tools. Control Systems: Mechanical & Electrical, Adaptive Control System, relays, push button control, electrical brakes, drum control.

Unit VI: Advances in Machine Tool Design (7)

Design considerations for SPM, NC/CNC, and micro machining, Retrofitting, Recent trends in machine tools, Design Layout of machine tool using matrices.

Text Books:

1. N. K. Mehta, "*Machine Tool Design*", Tata McGraw Hill, ISBN 0-07-451775-9.
2. A. Bhattacharya and S. G. Sen., "*Principles of Machine Tool*", New central book agency Calcutta, ISBN 81-7381-1555.
3. D. K Pal, S. K. Basu, "*Design of Machine Tool*", 4th Edition. Oxford IBH 2005, ISBN 81- 204-0968.

Reference Books:

1. N. S. Acherkan, "*Machine Tool*", Vol. I, II, III and IV, MIR publications.
2. F. Koenigsberger, "*Design Principles of Metal Cutting Machine Tools*", The Macmillan Company New York 1964.

411124 (b): ELECTIVE I : AUTOMOBILE ENGINEERING & MANUFACTURING

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Basic Mechanical Engineering, Machine Drawing, Theory of Machines, Basic Electrical & Electronics Engineering, Design Machine Elements, Thermal Engineering

Course Objectives:

1. Study of Structure of Automobile & Fuel Supply System.
2. Study of Cooling System & Lubrication System.
3. Study of Ignition System & Lubrication System.
4. Study of Clutches & Gear Boxes.
5. Study of Suspension & Steering Systems.
6. Study of Braking System & Automobile Maintenance Techniques.

Outcomes:

Upon successful completion of this subject student should be able to….

1. Understand Structure of Automobile & Fuel Supply System.
2. Explain the Cooling System & Lubrication System.
3. Understand Ignition System & Lubrication System.
4. Understand Clutches & Gear Boxes.
5. Learn Suspension & Steering Systems.
6. Know the procedure of using Braking System & Automobile Maintenance Techniques.

UNIT I: STRUCTURE OF AUTOMOBILE AND FUEL SUPPLY SYSTEMS (7)

Introduction: Vehicle specifications, Automobile Frames and Chassis Layout, classification of vehicles and chassis, main components of an automobile, articulated vehicles.

SI Engines: Carburetion, air fuel requirements for SI engines under various operating conditions, different circuits, fuel injection in SI engines.

CI Engines: Functional requirements of an injection system, typical arrangement of solid injection system, individual pump and; nozzle system, unit injectors, distributor system, fuel injectors, types of nozzles, governing of IC engines.

UNIT II: COOLING AND LUBRICATION SYSTEM (7)

Need for cooling, types of cooling systems- air and liquid cooling systems. Thermo syphon and forced circulation and pressurized cooling systems. Properties of coolants. Requirements of lubrication systems. Types-mist, pressure feed, dry and wet sump systems. Properties of lubricants.

UNIT III: IGNITION SYSTEMS AND SENSORS IN AUTOMOBILES (7)

Ignition Systems: Types, Construction & working of battery coil and magneto ignition systems, Relative merits, types and Construction of spark plugs, electronic ignition systems Basic sensor arrangements:

Types of sensors – oxygen sensor, vehicle speed sensor, detonation sensor, accelerometer sensor, crank position sensor.

UNIT IV: STUDY OF CLUTCHES AND GEAR BOXES (7)

Types of clutches, single plate, multiplate, centrifugal clutches, clutch operating systems, wet clutches, fluid coupling, clutch plate material. Need and Objectives of Gear box, Functions of gear box, various resistances to motion, rolling, air and gradient resistance, total resistance and tractive effort, variation of tractive effort with speed, power required for acceleration and gradiability, selection of gear ratio, sliding mesh, constant mesh and epicyclic gear boxes, synchromesh devices, automatic gear boxes, torque converters, overdrive.

UNIT-V STUDY OF SUSPENSION AND STEERING SYSTEMS: (7)

Requirement of Suspension Systems, Types of suspension Springs, Constructional details and characteristics of Single Leaf, Multi-Leaf Springs, Coil and Torsion bar system, rubber springs, spring and unspring mass, shock absorbers, independent suspension, air suspension, interconnected suspension, hydro pneumatic suspension, self levelling suspension.

Steering Systems: Steering geometry: Ackerman and Davis steering system, Constructional details of steering linkages, camber, steering axis inclination, included angle, scrub radius, castor, toe in, toe out, turning radius, wheel balancing, steering gears, cornering force, slip angles, under steer, over steer, cross play and radial tyres, power steering.

UNIT-VI: STUDY OF BRAKING SYSTEMS AND AUTOMOBILE MAINTENANCE TECHNIQUES (7)

Brake and Wheels: Drum brakes, Disc brakes, front and rear brake links layouts. Spoke wheel, Cast wheel, Disc wheel, Disc types, Tyres& tubes.

Automobile Maintenance: Preventive maintenance system in transport industry, troubleshooting and diagnosis for the systems that constitute an automobil

Text Books:

1. V. Ganesan, "*Internal Combustion Engines*", Tata McGraw Hill Publishing Company Ltd,2007
2. M.L. Mathur, and R. P. Sharma, "*A course in I.C. Engine*", Dhanpat Rai Publication, Seventh Edition, New Delhi, 1999.

Reference Books:

1. Newton, Steeds and Garrett. "*Motor Vehicle*", The English Language Book Society, Ninth Edition, 1972.
2. W. H. Crouse, "*Automotive mechanics*", Tata McGraw Hill Publishing Company Ltd, New Delhi, Ninth Edition, Delhi, 1993. ,ISBN0070634351
3. Kirpal Singh, "*Automobile Engineering*",Vol. II,Standard Publishres Distributors,(2009),ISBN8180141241
4. Narang G. B. *S.,* "*Automobile Engineering*", S. Chand and Company Ltd, Fifth Edition, Delhi, 1995.
   Heitner Joseph, "*Automotive Mechanics*" CBS Publishers and Distribution, Second Edition, Delhi, 1987.

5. P. L. Ballancy, "*Internal Combustion Engines*", Khanna Publishers, Third Edition, New Delhi,1991.
6. P. W. Gill, J. H. Smith, "*Fundamental of I.C. Engines*", Oxford and IBH Publishing Co. Pvt. Ltd., (2007) ,ISBN8120417100
7. Arkhangelsky V. et.al., "*Motor Vehicle Engines*", MIR Publishers, Mascow1976
8 R. K. Rajput, "*A Text Book of Automobile Engineering"*Firewall Media, 2007, ISBN 8170089913

411124 (c): ELECTIVE I: COMPUTER INTEGRATED MANUFACTURING AND INDUSTRIAL ROBOTICS

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Engineering Mathematics, Basic Electrical Engineering, Basic electronics, Engineering; Design of Machine Element, Manufacturing Process, Kinematics Design of Machines, Computer Applications in Production Engineering; Mechatronics & Robotics

Course objectives:

1. To understand basic concepts of CIM system in manufacturing industry.
2. To understand basic role of kinematics and dynamics in robotics.
3. To study various hydraulic circuits, control system & transmission system.
4. To understand basic concept of industrial drives & circuits.
5. Student is able to understand applications of various sensors in automation.

Outcomes:

1. Student is able to solve the problems based on modeling and simulation principal.
2. Student is able to apply geometric & kinematics principles to design components.
3. Student is able understand electric, electronics & computer control systems used in automation.
4. Design the application circuit as per required automation by understanding the basic layout and components location in hydraulic and pneumatic circuits.
5. Student is able to understand applications of various sensors in automation.
6. Ability to do develop automation by learning & developing various innovative methods.

Unit I: CIM Models and Rapid Prototyping **[7]**

Introduction, ESPRIT – CIM OSA Model, The NIST – AMRF Hierarchical Model, The Siemens Model of CIM, The CIM model of Digital Equipment Corporation, IBM concept of CIM, Present Scenario, Rapid Product Development and Manufacture, Extended Enterprises. Methods of rapid prototyping: steriolithography, Laminated Object Manufacturing (LOM), Fused Deposition Modeling (FDM), selective laser sintering, solid ground curing, 3D Printing system, Application of rapid tooling methods to press tool manufacture.

UNIT II: Robot arm kinematics and dynamics **[7]**

Basic structure of robots, Configuration of robots, arm body, wrist motion, The direct kinematics problem, the inverse kinematic solution, Homogeneous transformation. Dennavit - Hartenberg's convention for dynamic analysis of Joints, Global & Local Coordinates for analysis. Advanced synthesis of planar mechanisms for ISP, MSP and FSP, Burmester theories and analytical techniques, Applications, Lagrange-

Euler formation, generalized D'Alembert equations of motion, Spatial mechanisms. Axodes, kinematics of open and closed loop mechanisms.

UNIT III: Robot Drives, Control and Transmission System [7]

Hydraulic systems, DC servo motors, basic control systems concepts and models, control system analysis, robot activation and feedback components. Positional and velocity sensors, actuators. Power transmission systems, robot joint control design. Transmission System: Basic Motion Conversion Systems, Efficient power transmission for robotics systems, Concepts and related terms of power transfer.

UNIT IV: **Robot Grippers [7]**

Classification, Design consideration, Materials for hostile operation. Cylindrical Cam type; Grippers using pneumatic, hydraulic and electrical motor for transmission; Vacuum Grippers, ultrasonic grippers. Finite element analysis in designing for gripper pressure for fragile & visco-elastic material. mechanical, hydraulic & pneumatic manipulator.

UNIT V: Sensors in Robotics [7]

Sensors - functioning, types, analysis and fields of applications. Tactile sensors, temperature sensors, Variable Pressure Light Converting Sensor, High Resolution Pneumatic tactile Sensor, Slip type Sensors, Piezo electric Contact Sensors. Remote Sensor Compliance, Range & Proximity Sensors, Electro- optical Sensors. Vision system: Median filtering, thresholding, discretization, Smoothening of binary image. Recognition Procedure. CCD Camera.

UNIT VI: Robot Application [7]

Computer Application in manufacturing automation and Robotics, Pick and place Robot, Arc Welding Robots, assembly and mega-assembly Robots, Walking Robots, Climbing Robots, Telechirs, Machine mounted Robots. Interfacing Robots with PC computers. Obstacle Avoidance: Lee's Algorithm; Counter Path Defining using 'via' point, blending technique. Methods of Programming the robot, Languages, Robo-graphics, Modeling in Robotic system, Simulation package, weld scanners in robotized welding etc.

Text Books:

1. S.R. Deb "*Robotics* ",Tata McGraw Hill.
2. YoramKoren, "*Robotics for Engineers*", McGraw Hill Book Co. ,ISBN007035399
3. M. P. groover, M. Weiss, R. N. Nagel, N. G. Odrey, "*Industrial Robotics Technology, Programming and Applications*", McGraw Hill Book Co.
4. R. K. Mittal, I.J. Nagrath, (2004), "*Robotics & Control*," Tata McGraw Hill, ,ISBN0070482934

Reference Books:

1. K. S. Fu, R. C. Gonzalex, C.S.G. Lee, "*Robotics Control Sensing, Vision and intelligence*", Tata McGraw Hill ,ISBN0070265100
2. Hartenberg and Denavit, "*Kinematics and Synthesis of Linkages*", McGraw Hill Book Co.
3. A. S. Hall, "*Kinematics and Linkage Design*", Jr.Prentice Hall.
4. J.J. Craig (2010), "*Introduction to Robotics - Mechanics and Control*." Pearson Education Inc., New Delhi

411124 (d): ELECTIVE I: PLASTIC ENGINEERING

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Chemistry, Manufacturing Processes

Course objectives:

1. To understand the mechanism of polymerization, techniques of polymerization and Condensation, Common alloys & blends, and colouring of plastics.
2. To provide the depth knowledge about different kinds of plastic materials based on their structure and properties.
3. To make the students familiar about properties and processing of plastics and use it for different applications.

Outcomes:

At the end of the course, the student will be able to

1. Select the plastic materials for particular end user application
2. Predict the structure and properties of different kind of plastic material
3. Know the processing of different plastic material based on the end user requirement.
4. know the finishing/machining processes required for plastic materials.

Unit I: Basic chemistry for plastic material **(7)**

Structure, Organic structure, Polymerization, Addition, Condensation, Classification of plastic, Additives of the plastic, Common alloys and blends, Coloring of plastics.

Unit II: Injection Molding **(7)**

Equipment, mould ability features, injection molding cycle, effect of processing on mechanical properties, Injection mould designs considerations, functions of register ring, sprue bush, cavity & core inserts, ejection of mold& cooling of Injection moulds.

Unit III: Extrusion **(7)**

Introduction to extrusion, single and twin screw extruder, vented barrel extruder, Blown film extrusion. Extrusion of pipes, sheets and filaments, Coextrusion of films and sheets, multiplayer films, dwell lip air ring, typical extruded dimensions. Special features of extrusion dies, Extrusion coating and lamination, Extrusion problems and Extruder performance.

Unit IV: Blow Molding (7)

Basic principles of blow molding, Types of blow molding, comparison of injection blow & extrusion blow molding processes, Materials for blow molding, Basic design considerations in blow molding, Bottle design concept, Surface treatment of container, Rotary injection blow molding, Stretch blow molding.

Unit V: Thermoforming (7)

Major Thermoforming processes, process factors in thermoforming, straight vacuum forming technique, plug assist-forming thermoforming of PP sheets, problems in thermoforming, twin sheet thermoforming, and maintenance.

Unit VI: Finishing and Machining of Plastics (7)

Filing, tumbling, ashing, buffing and polishing of thermosetting and thermoplastic. Machining of plastics - principle considerations, guidelines for tool geometry, drilling and reaming, tapping and trading, turning and milling, sawing, piercing, trimming and routing of thermosetting and thermoplastics.

Text Books:

1. William J. Patton, "*Plastic Technology*, Tarapurwala and Sons.
2. Akira Kobayashi, "*Machining of Plastics"*, Robert A Krieger Publication, 1981.
3. Batra, "*Design of Blow Moulds",* CBS Publishers & Distributors, 2007,ISBN8123914954
4. J.L. Throne, *"Technology of Thermoforming",* Hanser Gardner Publications, 1996,ISBN1569901988
5. Brent Strong, "*Plastics: Materials Processing",* 3rd Ed., Prentice Hall,2005,ISBN0131145584
6. Date P. P., "*Introduction to Manufacturing Technology, Principles and Practices*", ,Jayco Publishers, Mumbai

References:

1. W.S. Allen, and P.N. Baker, "*Handbook of Plastic Technology",* Vol I &II, CBS Publishers.
2. A.S. Athlye, "*Plastic Processing Handbook"*, Multitech Publication.
3. Christopher Lefteri, "*Plastics Handbook"*, RotoVision Publication, 2008

411125 (a): ELECTIVE II: ERGONOMICS AND HUMAN FACTORS IN ENGINEERING

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks
		End-Sem: 70 Marks

Pre-requisites: Human physiology, Basic physics, working environment

Course objectives:

1. An ability to apply ergonomic principles in industry and society
2. An ability to identify & solve engineering problems applying principles of physiology & anthropometry.
3. An ability to design displays
4. An ability to design a system & work environment.
5. Proficiency in Human factors applications in system design, characteristics of system design.
6. Proficiency in design with time & motion study principles.

Course Outcomes:

After learning this subject students will be able to:

1. Understand scope and need of applying Human Factors Engineering in industry and society
2. Design workplaces and products ergonomically by applying principles of design, work physiology and anthropometry.
3. Understand information input and processing to design visual and auditory displays.
4. Evaluate and estimate human efficiency and by understanding work physiology
5. Design work environment by applying knowledge of Physiological effect of environmental conditions on human performance.
6. Apply knowledge of Human Factors in Ergonomic system design

Unit I: Introduction to Human Factors: (7)

Human criteria's, human physical activities, features of the human body, Measures of physiological functions such as: energy expenditure, gross body activity, local muscular activity, work load, work efficiency, work and rest. Type of movements of body members. Performance criteria for physical activity such as: Strength &endurance, speed of movements, accuracy of movements, manual material handling (MMH).

Unit II: Applied Anthropometry and Work Space: (7)

Introduction to anthropometry, use & principles of anthropometry data, work spaces, work space envelopes for seated persons, design of work spaces such as: work surface height, seated & standing, principles of seat design, workplace design. Physical space & arrangement, principles of arrangement of component,

Unit III: Design of Displays **(7)**

Information input & processing, visual displays of static & dynamic information. Auditory, textual & olfactory displays, general location of controls & displays within workspace, concept of visibility.
Human Controls of Systems Functions of controls, types of controls, factors in control design, design of specific hand operated controls, foot controls and special control devices.

Unit IV: Working Conditions **(7)**
Illumination: Color systems, energy consideration, effect of lighting on performance. Atmospheric conditions: Measurement of thermal variables, wet-bulb globe temperature, Botsball, heat stress index, heat index, wind chill index, physiological effect of heat & cold on performance. Noise: Physiological effect of noise on performance, noise exposure limits, noise controls.

Unit V: Ergonomics and Work Organization **(7)**
Human factors applications in system design, characteristics of system design, human factors data for interface design, ergonomic safety & health management, case studies of ergonomically designed product.

Unit VI: Advanced Time and Motion Study: **(7)**
Predetermined Motion Time Analysis (PMTS) Method Time Analysis (MTA), work factor system (WFS), method time measurement (MTM-1, MTM-2, MTM-3), Maynard's operation sequence technique (MOST),

Text Books:
1. ILO,"*Introduction to work-study*", Universal Publishing Company, ISBN 81-8502700-4.
2. M.S. Saunders, EJ McCormick, "*Human Factors Engineering and Design*", McGraw Hill, ISBN0070549017
3. R. M. Barnes, "*Motion and Time Study Design and Measurement of work*", John Wily and Sons, ISBN 0-471-08335-6.

Reference Books:
1. M. S. Sanders & McCormick E. J., "*Human Factors in Engineering & Design*", McGraw-Hill International Editions, ISBN 0-07-100319-3.
2. R. S. Bridger, "*Introduction to Ergonomics*", McGraw-Hill International Editions, ISBN 0-07-113294-5.
3. E. Grandjean ,"*Fitting the Task to the man*", Taylor and Francis London.
4. Maynard, Industrial Engineering Handbook, McGrawHill Professional & Publishing (2001), ISBN0070411026

411125 (b): ELECTIVE II: MATERIALS MANAGEMENT AND LOGISTICS

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theroy: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Knowledge of courses Production and Industrial Management I & II.

Course Objectives:

The purpose of this course is to make students:

1. understand the basic aspects of material management in industrial perspective
2. know what is value engineering and perform analysis for cost reduction
3. be aware of purchasing and stores management in industry
4. recognize the system and techniques of logistics management and economics of it
5. understand and demonstrate the concept of inventory management and management models in industry

Outcomes:

By the end of the course, students will be able to:

1. explain the basic aspects of material management in industrial perspective
2. demonstrate the concept of value engineering and analysis for cost reduction
3. illustrate the system and techniques of purchase and stores management
4. illustrate the system and techniques of logistics management and
5. describe the concept of inventory management and relate the management models in industrial scenario

Unit I: Materials Management **(7)**

Introduction to Material Management functions, scope, objectives, tools and techniques. Make or buy decision. Material Requirement Planning (MRP1).

Value analysis

Value analysis / Value analysis engineering, concepts, advantages, applications, problem recognition, role of creativity, analysis of functions, use, esteem and exchange values elimination of unnecessary costs, value engineering techniques.

Unit II: Purchase Management **(7)**

Objectives, functions, purchase cycle, documents in purchasing, purchasing with 5 R'S (Quality, Quantity, Time, Supplier, Price),vendor rating and vendor development. Import and Import Substitution: Factors affecting National and International markets, Import procedure and documents (Bill of lading, letter of credit etc.)

Unit III: Stores Management (7)

Functions of stores, types of stores, stores identification, receipt-issue, recording system, stock taking system. Waste Management: Importance of waste management and techniques. Waste management system, Disposal of surplus and obsolete items. Mechanical and thermal disposal system.

Unit IV: Logistic Management (7)

Operating Responsibility, Logistical performance Cycle, Work of Logistics, Functional areas of logistics . Warehouse Management: Nature and importance of warehousing, warehouse location, warehousing operations and Facility development. Economic and service benefits of warehouse. Transportation management: Transport planning parameters, Basic Economics & pricing factors affecting transportation cost.

Unit V: Inventory management (7)

Types of inventory, Cost related to Inventory management, selective control of inventories, economic order quantity (EOQ) models, quantity discount model.

Unit VI: Inventory control of finished goods (7)

Economic manufacturing quantity (EMQ), Fixed order quantity and fixed order interval system, Probabilistic models, Safety stocks, service levels, inventory control of finished goods, single order inventory policies. Inventory models under risk and under uncertainty.

Text Books:

1. L. D. Miles, “Techniques of Value Analysis and Engineering”, McGraw Hill Education,ISBN0070419264
2. James R. Stock and Diouglas M. Lambert, “Strategic Logistics Management” IVth edition, McGraw Hill International Edition,ISBN0071144927
3. Doubler&Lee,”Purchasing and Material Management”, Tata McGraw Hill, ISBN 0-07- 462082-7
4. L.C. Jhamb,”Inventory Management”,Everest Publications, ISBN 81-86314-54-7.

Reference Books:

1. Simchi-Levi, Kaminsky, “Designing and Managing the Supply Chain, Concepts Strategies and Case studies”, 2ndedition, Tata McGraw Hill, ISBN 0-07-058666-7
2. D. J. Bowersox, D. J.Closs, “Logistical Managemant”, McGraw Hill Book Company, ISBN 0-07
3. K.S. Menon,”Purchasing& Inventory Control”, Wheeler Publications, ISBN 81-85814-10.

411125 (c): ELECTIVE II: FINANCIAL MANAGEMENT AND COST CONTROL

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theory: 03	In-Sem: 30 Marks End-Sem: 70 Marks

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Pre-requisites: Production and Industrial Management – I & II

Course objectives:

- To provide the participants a thorough grounding of financial management concepts and preparation of Financial Statements with their analysis.
- To gain expert knowledge of principles and concepts used in finance;
- To learn to manage short-term resources of a business firm
- To be able to find out the best course of action among several financial options;
- To help understand costing and management accounting techniques that could be utilized for decision making and control.

Outcomes:

After learning this subject, the student will:

1. Use Financial Statements to evaluate firm performance.
2. Calculate time value of money and Cost of Capital.
3. Demonstrate how materials, labor and overhead costs are added to a product at each stage of the production cycle.
4. apply cost accounting techniques and evaluate their limitations;
5. use and evaluate appropriate costing and decision making techniques to make short term decisions;
6. use standard costing systems to undertake a performance review and interpret the results

Unit I: Financial Management [7]

Financial Function, Scope, goals and tools. Sources of finance, corporate planning and financial management. Financial Statements: Balance sheet, profit and loss account. Ratio Analysis: Classification, Ratio Analysis and its limitations. Operating and Financial Leverage.

Unit II: Capital Budgeting [7]

Control of Capital Expenditure, Evaluation Process-Payback approach, Accounting of Rate of Return, Present Value Method Vs Internal Rate of Return. Replacement cost and discounted cash flow.

Unit III: Working Capital Management [7]

Concept and design of Working Capital, types of working capital, sources of working capital, time value of money, cost and capital, cost of capital. Funds Flow Analysis: Concepts, Objectives, and Techniques of Funds Flow Statement.

Unit IV: Costing **[7]**

Methods of costing and elements of cost. Material Cost: Different methods of pricing of issue of materials. Material losses - Wastage and its consideration. Labour Cost: Different methods wages and incentive plans. Principles of good remunerating system, labour turnover and its methods. Depreciation: Concept, importance and different methods of depreciation. Estimation of material, machining and labour cost machining. Overheads: Classification, collection of overheads, Primary and Secondary apportionment of overheads, absorption of overheads. Machine hour and labour hour rate. Under and over absorption of overheads. Estimation of overheads.

Unit V: Budgetary control and variance Analysis: **[7]**

Material, Labour , Overhead, Sales. Profit, Product-mix and Yield Variance. Cost control: Capital cost control-the nature of control, elements of cost control programme, project planning and scheduling, cost reporting and corrective action. Capital cost control repetitive operating cost, standard costs, cost reporting and corrective action.

Unit VI: Types of Costing Methods **[7]**

Concept, development & use of standard costing, Marginal Costing: Use of Marginal Costing in decision-making Activity based costing: Concept, cost drives, applications. Process costing: Concept, transfer cost, concept of by products, joint costing, scrap, waste, losses, cost of quality.

Text Books:

1. N. K. Prasad, "*Principles and Practice of Cost Accounting*", Syndicate Pvt. Ltd., Calcutta700 009.
2. I. M. Pandy, "*Financial Management*", New Delhi Vikas Publication House Pvt. Ltd., ISBN81-259-0638-X
3. M. Y. Khan, P. K. Jain, "*Financial Management*", Tata McGraw Hill Publishing Ltd.
4. B. K. Bhar, "*Cost Accounting Methods and Problems*", Academic Publishers, Calcutta

Reference Books:

1. Henry M. Steiner, *"Engineering Economics Principles",* McGraw Hill Publication.
2. C.B. Gupta, *"Fundamentals of Business",* Sultan Chand & Co.,
3. P. A. Samualson, *"Economics",* McGraw Hill International.
4. K. K. Dewett, *"Modem Economic Theory",* Sultan Chand & Co., ISBN 81-219-0331-1
5. Colin Drury, "*Management and Cost Accounting*", English Language Book Society,Chapman& Hall London.

411125 (d): ELECTIVE II: PRODUCT DEVELOPMENT

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 03 hours / week	Theory: 04	In-Sem: 30 Marks End sem70 Marks

Prerequisites: Basic manufacturing concepts , Basics of Engineering Graphics, Engineering Design, Engineering Graphics, Design of machine elements

Course Objectives:

1. Understand the basic concepts of Design and Development, comparison between validation and verification, morphology of product design
2. Understand the technical and business consensus of Product Development
3. Understand Product development concept to product function
4. Understand product development in context of reverse engineering.
5. Develop an understanding of design for manufacture, assembly and environment
6. Get introduced to concept of PLM and PDM

Course Outcomes:

Student shall be able to

1. Understand the basic concepts of Design and Development, comparison between validation and verification, morphology of product design
2. Understand the technical and business consensus of Product Development
3. Understand Product development concept to product function
4. Understand product development in context of reverse engineering.
5. Develop an understanding of design for manufacture, assembly and environment
6. Get introduced to concept of PLM and PDM

UNIT I: Introduction to Product Design & Development (7)

Definition of product design, design by evolution and innovation, factors in product design, morphology of product design (seven phases), standardization, simplification and specialization in product design, modern approaches- concurrent design and quality function deployment, product development, product development versus product design, types of design and redesign, modern product development process, product development team and product development planning with reference to ISO standard, difference between product verification and production validation, introduction to prototyping, rapid prototyping methods.

UNIT II: Product Development - Technical and Business Concept (7)

Technology Forecasting and Technology S-Curve (Technology Stage), Mission Statement and Technical Questioning, Economic Analysis of Product, Customer Needs and Satisfaction, Customer Population and Market Segmentation, Customer Needs-Types and Models, Gathering Customer Needs Information, Analysis *of* Gathered Information.

UNIT III: Product Development from Concept to Product Function (7)

Generating concepts, information gathering, and brainstorming, morphological analysis, concept selection design evaluation, estimation *of* technical feasibility, concept selection process, Pugh's concept, selection charts, numerical concept scoring, process of concept embodiment, system modeling, FMEA, functional modeling and decomposition, fast method, subtract and operate procedure, establishing system functionality, augmentation and aggregation.

UNIT IV: Product Development in the Context of Reverse Engineering (7)

Product Teardown Process, Tear Down Methods - Force Flow Diagrams, Measurement and Experimentation, Applications of Product Teardown, Benchmarking Approach and Detailed Procedure, Tools Used In Benchmarking - Indented Assembly Cost Analysis, Function -Form Diagrams, Trend Analysis, Setting Product Specifications, Introduction to Product Portfolio and Architecture.

UNIT V: Design for Manufacture, Assembly and Environment (7)

Design guidelines, design for manufacture, design for assembly, design for piece part production, manufacturing cost analysis, need and importance of design fo*r* environment, global, local and regional issues, basic DFE methods-guidelines and applications, life cycle assessment - basic method, weighed sum assessment method, life cycle assessment method, DFX, product testing, product validation, field trials, virtual trials, iterations

UNIT VI: Introduction to Product Life Cycle and Product Data Management (7)

Background, Overview, Need, Benefits, and Concept of Product Life Cycle, Components/Elements of PLM, Emergence of PLM, Significance of PLM, Customer Involvement, Product Data and Product Workflow, The Link Between Product Data and Product Workflow, Different Phases of Product Life Cycle and corresponding technologies. Reliability concepts in product development.

Text Books:

1. A.K. Chitale; R.C. Gupta, "*Product Design and Manufacturing*" Prentice – HallIndia
2. Kevin Otto and Kristin Wood" *Product Design: Techniques in ReverseEngineering and New Product Development*," , Pearson Education Inc

References:

1. Dieter George E., "*Engineering Design*"McGraw Hill Pub. Company, 2000.
2. Grieves, Michael" *Product Lifecycle Management*", McGraw-Hill, 2006. ISBN0071452303
3. Bralla, James G Handbook of Product Design for Manufacturing, McGraw HillPub.1986
4. ISO Standard: 9001:2008: Clauses 7.1, 7.2, 7.3

411126: OPERATIONS RESEARCH AND MANAGEMENT LAB

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 02 hours / week	Credit: 1	Term Work: 50 Marks

One exercise on each unit of subject syllabus (Operations Research & Management).

At least one Computer software package such as Lindo/Lingo, MS-Project, MATLAB, MS-Excel and Tora should be used.

411127: MECHATRONICS AND ROBOTICS LAB

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 02 hours / week	Pr/Or: 01	Pratical:50 Marks

Experiments: (Any Eight)

The term work shall consist of following experiments and one assignment on each unit.

1. Experiment on control system using Pneumatic or Hydraulic kit.
2. Problem analysis in pneumatic or hydraulic system.
3. Program on microcontroller / microcontroller simulator.
4. Ladder diagram and programming using PLC.
5. Experiment on process control loop including sensors, controllers and final control elements/actuators.
6. Experiment on ADC/DAC used in Data Acquisition System (DAQ).
7. Experiment on displacement level and pressure control.
8. Experiment on Measurement of speed
9. Experiment on of temperature.
10. One experiment on pick and place robot (2D robot).
11. Assignment on Internet of things (IOT) / Artificial Intelligence.

**** Under oral head examination should be based on term wok completed during practical and Theory syllabus**.

411128: ADVANCED PRODUCTION TECHNOLOGY LAB

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 02 hours / week	Pr/Or: 01	Pratical:50 Marks

The term work shall consist of record of assignments on following topics.

1. Study of different types of Hydraulic control valves, actuators, accumulators & pumps.
2. Study of hydraulic circuits: - hydraulic press, machine tools, automobile systems, etc
3. Experimentation on Performance analysis of positive displacement pumps.
4. Experimentation on Hydraulic Circuits – Meter-in, Meter-Out, Bleed off, Regenerative, Sequential and Automatic To and Fro using Electro-hydraulic circuit etc. (minimum 6 circuits)
5. Experimentation on Pneumatic Trainer: preparation of Pneumatic circuits using different control Valves (minimum 6 Circuits)
6. Study of automation in material handling system and AGV.
7. Study of Control system in various types of feeders.
8. Study of Rapid prototyping Technology

Two Assignments Based On Advanced Machining Process and Nano Technology and Nanofabrication

411129 (a) : ELECTIVE I : MACHINE TOOL DESIGN LAB

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 02 hours / week	Pr/Or: 01	Pratical:50 Marks

Term work:

Term work shall consist of record of assignments on following topics.

1. Design and working drawing of speed gear box
2. Design and working drawing of feed gear box
3. Study of stepless drives
4. Design of bed or column.
5. Design for spindle or power screw.
6. Design for guideways and slideways.
7. Internet assignment based on any one of the topics above.

411129 (b): ELECTIVE I : AUTOMOBILE ENGINEERING & MANUFACTURING LAB

Teaching Scheme	Credit Scheme	Examination Scheme
Practical: 02 hours / week	Pr/Or: 01	Pratical:50 Marks

Term work:

Term work consist of the following

1. Four assignments on syllabus of Automobile Engineering & Manufacturing
2. Four assignments on automotive sheet manufacturing viz. Stamping & Forming, automotive joining, Automotive painting & final assembly etc

411129 (c): ELECTIVE I : COMPUTER INTEGRATED MANUFACTURING AND INDUSTRIAL ROBOTICS LAB

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Practical: 50 Marks

Term Work:

Practical: Journal must contain detailed report of any five of the following practical, essentially with one demonstration, one gripper design and an industrial visit.

1. Demonstration of Cartesian/cylindrical/spherical robot.
2. Demonstration of Articulated/ SCARA robot.
3. Virtual modeling for kinematic and dynamic verification anyone robotic structure using suitable software.
4. Design, modeling and analysis of two different types of grippers.
5. Study of sensor integration.
6. Two program for linear and non-linear path.
7. Study of robotic system design.
8. Setting robot for anyone industrial application after industrial visit.

411129 (d): ELECTIVE I: PLASTIC ENGINEERING LAB

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Practical: 50 Marks

Term Work:

Any six assignments based on the above syllabus (One from each unit)

411130: COMPUTER APPLICATIONS IN PRODUCTION ENGINEERING LAB

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 01	Term Work: 50 Marks

Prerequisites: Fundamental of programming Languages, Engineering Graphics, Computer Graphics, Design of Machine Elements

Course objectives:

1. The students completing this course are expected to understand the role of computer in design, modeling and manufacturing industry.
2. To understand the various automated manufacturing activities
3. To study the application of computer Technology in the Manufacturing activities
4. To know the smooth transition from conventional manufacturing to automated production and computer integrated manufacturing

Outcomes:

1. Show improved ability of student to look into industrial problem with an understanding and importance for design and quality .
2. Demonstrate the understanding of various mathematical elements in computer graphics by solution with programming skills.
3. Demonstrate the understanding of the concept of FEA by solving with a relevant tool.
4. Able to create simulation of CAM process using DELCAM Tool.
5. Path generation and process simulation.
6. Create competitive advantage through learning of advanced

Term work consisting of writing the journals based on following points. Any six assignments from following.

1. Study of basics of Computer Aided Design.
2. One Assignment based on 3-D Transformations like 3D translation, rotation, scaling. Coding in Programming Language.
3. Computer Programme for Stiffness Matrix solution using software package.
4. Finite Element Analysis of a component using any of solver like for any one application like Static, Thermal, Vibration Analysis.
5. Formability analysis of sheet metal part using any software.
6 Tool Path generation & Computer Aided Manufacturing using any CAM module.
7 Parametric Programming for Tool Path Generation.
8. Study of Computer Application in Process Planning, Quality Control (CAPP& CAQC) & Rapid Prototyping (RP)
9 Case study of implementation of product data management (PDM) & Product Life Cycle management (PLM) in industry.

10 Actual product design with virtual product validation
11. Computer application in QFD and FMEA

Reference Books:

1. Mikell P. Groover & Emory W., Zimmers J., "*CAD/CAM*", PHI Publications.
2. P. Radhakrishana, S. Subramanyam, CAD/CAM/CIM, New Age International Pvt Ltd Publishers
3. N.K Chougule,"*CAD/CAM/CAE*", Scitech Publications.

411131: INDUSTRIAL INPLANT TRAINING

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 12	Practical: 250 Marks

Objectives:

1. To enable students to learn the basic concepts of Project & Production Management.
2. To enable students to implement Project Planning in their Industrial In-plant Training Project work.
3. To be capable of self-education and clearly understand the value of achieving Perfection in the respective Project work.
4. To study the concept of Facility, Location & Layout & implement in their Industrial In-plant training Project work.
5. An understanding of the impact of engineering solutions and industrial safety in a global and social context.

Outcomes:

The student shall undergo industrial training for the period of 6 months in an industrial establishment and spend about 8 weeks for observational training and solving minimum three assignments given by the organization. The remaining period shall be utilized for project (411132). Students are expected to analyze the problems systematically and offer suggestion / concluding remarks.

Training:

The student shall undergo training program prepared by the industry in following manufacturing and functional area.

1. Plant Engineering: Plant Layout, Plant Maintenance, Housekeeping, Material Handling & safety.
2. Production Planning And Control, Quality Assurance.
3. Material Management: Inventory Control, Vendor Development, Vendor Rating, Raw Material and Finished Goods stores.
4. Industrial Engineering: Method Study, Work Measurement, Ergonomics and Productivity Improvement Technique.
5. Costing and Cost Control.
6. Management Information System (M.I.S.).
7. Incentive Schemes, Labor Laws. Factory Acts.
8. Import Export Procedures.
9. Machine / Process Diagnosis.
10. Quality Assurance, Quality Improvement.
11. Improvement in tool layout, tool selection machine selection.
12. Maintenance of machines, housekeeping, safety precautions.
13. Computer based information study for stores, purchase wastage of material, In process material planning and scheduling, assembly of storage of finish product dispatch.
14. Incentive schemes, labor laws, factory laws.

The students shall submit a detailed report on his training and assignments.

411132: PROJECT

Teaching Scheme	Credit Scheme	Examination Scheme
Lectures: 02 hours / week	Pr/Or: 04	Practical: 200 Marks

1. Understand the basic concepts & broad principles of Industrial projects
2. Understand concepts of Project and Production Management
3. Get capable of self education and clearly understand the value of achieving perfection in project implementation & completion.
4. Apply the theoretical concepts to solve industrial problems with teamwork and multidisciplinary approach

Outcomes:

5. Enable the students to implement project planning in their Industrial In-Plant training work
6. Demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context

The student shall submit a report on project, suggested by industry where he is undergoing for Inplant training. The scope of the project shall be such as to complete it within the time schedule.

Project may be of the following types:

1. Manufacturing / Fabrication of a prototype machine including selection, concept Design, material selection, manufacturing the components, assembly of components, Testing and performance evolution.
2. Improvement of existing machine / equipment / process.
3. Design and Fabrication of Jigs and Fixtures, dies, tools, special purpose equipment, and inspection gauges, measuring instruments for machine tools.
4. Computer aided design, analysis of components such as stress analysis.
5. Problem related to productivity improvements.
6. Problem related to value engineering.
7. Problem related to material handling system.
8. Energy audit of organization, industrial evaluation of machine devices.
9. Design of a test rig for performance evaluation of machine devices.
10. Product design and development
11. Detailed cost estimation of product.
12. Analysis, evaluation and experimental verification of any engineering problem encountered.
13. Quality system and management, Total quality management.
14. Quality improvements In-process Inspection Online gauging.
15. Low cost Automation, Computer aided automation in Manufacturing.
16. Time and Motion Study, Job evaluation.
17. Safety.
18. Management Information System.
19. Market analysis in conjunction with production, planning and control.

20. Any other relevant topic.

The student shall submit a detailed report based on the project work.

Format of the project report should be as follows:

1. Paper: The Project report should be types. printed on white paper of A-4 size.

2. Typing: The typing shall be with single spacing and on one side of the paper.

3. Binding: The Industrial Inplant Report should be submitted with front and back cover in black hand bound, with golden embossing.

4. Margins: Left - 1.25", Right - 1". Top & Bottom 1 ".

5. Sequence of Pages:

5.1. Title page
5.2. Certificate form Institute
5.3. Completion Certificate form Industry, if sponsored.
5.4. Acknowledgement
5.5. Abstract
5.6. Index
5.7. Nomenclature & Symbols
5.8. Actual Content
5.9. Conclusion
5.10. References.

6. Front cover:

The front cover shall have the following details in block capitals

6.1 Title at the top.
6.2 Name of the candidate in the centre, and
6.3 Name of the Institute, Name of Industry, if sponsored and the year of submission on separate lines, at the bottom.

7.Blank sheets : No blank sheets be left any where in the report.

8. Project Completion Certificate:

The approval sheet follow the title sheet and shall be as shown with proper spacing.

CERTIFICATE

This is to certify that Mr ./Ms …… has carried out a Project entitled (Name)……. during the course of his (Name of Project) training at …….. (Name of Industry) in partial fulfillment of the requirement of the B.E. Production Sandwich Course of University of Pune at …… during the academic Year …….. (Name of Industry)

Date: (Guide)

Place:

(Examiner) (Head of Department)

9. Two copies of Industrial Implant Training & Project shall be submitted to the college. The student shall present their project before the examiners. The oral examination shall be based on the term work submitted, and jointly conducted by an internal and an external examiner from industry.

411133: TECHNICAL PAPER PRESENTATION

Teaching Scheme	Credit	Examination Scheme
2 Contact hours/Week01	Oral: 25 Marks	Term work: 25 Marks

Outcomes:

1. Develop interest towards research oriented field with ability to search the literature and brief report preparation.
2. Develop the skills, competencies and points of view needed by professionals in the field most closely related to the course
3. Discussion and critical thinking about topics of current intellectual importance
4. Ability to understand advanced technology and research in engineering.
5. Develop presentation skills.

Technical Paper Presentation shall be based on deep study of any topic related to Production Engineering; Format of the report shall be as follows:

1. Paper: The Technical Paper Presentation report should be typed/printed on white paper of *A-4* size.

2. Typing: The typing shall be with single spacing and on one side of the paper.

3. Binding The Technical Paper Presentation report should be submitted with front and back cover of card paper neatly cut to size and spiral bound together with the text.

4. Margins Left - 1.25", right - 1", Top & Bottom 1".

5. Sequence of Pages:

Title Page

Report Approval Sheet.

Acknowledgement

Abstract

Contents

Nomenclature & Symbols

Actual Content

Conclusion

References

6. Front cover:

The front cover shall have the following details in block capitals. .

i. Title at the top.

ii. Name of the candidate in the centre, and

iii. Name of the Institute and the year of submission on separate lines, at bottom.

7. Blank Sheets

No blank sheet be left any where in the report.

8. Title sheet

The title sheet shall be the first sheet and shall contain following details with proper spacing.

Technical Paper on

(TITLE)

By

(Name)

{Examination No. (Roll No.)}

Under Guidance of

9. Report Approval sheet:

The approval sheet shall follow the title sheet and shall be as shown with proper spacing.

This is to certify that the Technical Paper entitled ……

submitted by…….. Examination No…….

is approved for the award of degree of B.E. (Production Engineering Sandwich)

of University of Pune, Pune during the academic year……

Date: (Guide)

(Examiner) (Head of Department)

10. The format of the Technical Paper report:

i. The report shall be presented in the form of a technical paper.

ii. The introduction should be followed by the Literature survey.

iii. Report of any analytical or experimental work done should follow the literature survey.

iv. Figures should be drawn on separate sheets and inserted on the page on which the text is typed. The figures are drawn in either permanent black, ink or printed on paper. The figures should be numbered.

v. Tables shall be typed in text. A separate sheet may be used, if necessary. the table shall be numbered.

vi. Mathematical portion of the text shall be preferably. If this is not possible, it should be written in permanent black ink, Lengthy Mathematical derivations shall not be included. Only the important steps and expressions shall be given.

vi. Discussions and conclusions shall form the last paragraph of the text.

11. References

The references shall form the last section and shall be followed by 'Appendix' if any. They should contain list of works (Papers, Books, etc.) referred to in the body of the text. The numbering shall be done in numerals (e.g. 1, 2,) indicated as superscript along with the author's name in the text. For any paper, the name of journals, the volume number, the page number and the year of publication in parenthesis. In case of references *from* journals and books in languages other than English the titles of the journal or book shall be translated into Latin script. For any book the information shall contain the names of authors, title, publisher and the year of publication in parenthesis. For papers and books with joint authorship the names of all the authors shall be introduced in the same order. The author's name shall be last name followed by initials.

12. The total number of typed pages excluding the cover should be from 15 to *20* only. All the pages should be numbered.

13. Two copies of report shall be submitted to the college. The students shall present the Paper before the examiners.

411134 (a): ELECTIVE III: SUPPLY CHAIN MANAGEMENT

Teaching Scheme	Credit Scheme	Examination Scheme
Self Study	Theroy: 04	In-Sem: 30 Marks
		End-Sem: 70 Marks

Pre-requisites: Production and Industrial Management, Basics of Finance and Accounting, Materials Management

Course Objectives:

1. Examine the design and performance of supply networks and processes in different business contexts.
2. Develop capabilities in logistics, digital coordination for supply chain integration, inventory management, risk pooling, procurement, product and process design, and international supply chain management.
3. Apply inventory models and techniques to create and recommend appropriate stocking solutions in various business settings.
4. Evaluate and recommend warehouse and Distribution Center Management strategies, tactics, and systems to ensure companies efficiently and effectively manage their distribution processes at the regional, national, and international levels.
5. Identify and assess tradeoffs between the three key areas of transportation, inventory, and warehouse/DC management and recommend actionable plans and strategies.
6. Coordinate between Supply Chain & E- Business, perform financial evaluation of supply chain decisions, the impact of financial factors on supply chain decisions

Outcomes:

Student shall be aable to

7. Examine the design and performance of supply networks and processes in different business contexts.
8. Develop capabilities in logistics, digital coordination for supply chain integration, inventory management, risk pooling, procurement, product and process design, and international supply chain management.
9. Apply inventory models and techniques to create and recommend appropriate stocking solutions in various business settings.
10. Evaluate and recommend warehouse and Distribution Center Management strategies, tactics, and systems to ensure companies efficiently and effectively manage their distribution processes at the regional, national, and international levels.
11. Identify and assess tradeoffs between the three key areas of transportation, inventory, and warehouse/DC management and recommend actionable plans and strategies.
12. Coordinate between Supply Chain & E- Business, perform financial evaluation of supply chain decisions, the impact of financial factors on supply chain decisions

Unit I: Introduction to Supply Chain Management (8)

Building a Strategic framework to Analyze Supply Chains: Understanding the supply chain, supply chain performance, Supply chain drivers & obstacles

Unit II: Planning Demand & Supply in Supply Chains (8)

Demand forecasting in supply chain, aggregate planning in supply chain, planning demand & supply in supply chains.

Unit III: Planning & Managing Inventories in a Supply in Supply chains (8)

Managing economies of scale in a supply chain: cycle inventory, managing uncertainty in supply chain: safety inventory, determining optimal level of product availability.

Unit IV: Design consideration in Supply Chain (8)

Transportation, Network Design, & Information technology in a supply chain: Transportation in supply chain, facility decisions: network design in a supply chain, information technology in a supply chain.

Unit V: Supply Chain Coordination (8)

Coordinating in a Supply Chain & role of E- Business: Coordination in a supply chain, E- business & the supply chain.

Unit VI: Financial consideration in Supply Chain (8)

Financial factors Influencing Supply Chain Decisions: Financial evaluation of supply chain decisions, the impact of financial factors on supply chain decisions, evaluating supply chain decisions using decision trees,

Text Books:

1. Sunil Chopra & Peter Meindl, "Supply Chain Management: Strategy, Planning, & Operation", Addison Wesley Long man.
2. A. J. Vanweela, "Purchasing & Supply Chain Management"Cengagelearning(Nov2004) ISBN 1844800245

Reference books:

1. R.H. Ballou, "Supply Chain Management" Pearson[2007] ISBN 8131705846
2. Simchi-Levi, Kaminsky, "Designing and Managing the Supply Chain, Concepts Strategies and Case Studies", 2nd edition, Tata McGraw Hill, ISBN 0-07-058666-7
3. R. Monczka, "Purchasing & Supply Chain Management" Cengage learning business Press., ISBN 140801744X

411134 (b): ELECTIVE III: PLANT ENGINEERING AND MAINTENANCE

Teaching Scheme	Credit Scheme	Examination Scheme
Self Study	Theroy: 04	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Production & Industrial Management

Objectives:

1. To acquaint with various plant organizing functions.
2. To familiarize with various type of maintenance work and systems in a plant.
3. To familiarize with various type of Plant Facilities and Layout Planning.
4. To acquaint with concept of energy conservation and Plant Safety.
5. To acquaint with advances in Maintenance Engineering.

Outcomes:-

At the end of the course, the student will be able to

1. Illustrate various organization of plant engineering.
2. Illustrate various Plant Facilities and Plant Layout Planning.
3. Apply knowledge to various Maintenance Management practices.
4. Demonstrate various operational and safety aspects.
5. Illustrate concepts of pollution control, noise control, fire control methods and recycling of waste.
6. Apply energy conservation programs.

UNIT I: Organization of Plant Engineering

Principles of Plant management functions. Classification of maintenance work-Routine maintenance, emergency work, service work, preventive maintenance. Project work, Corrective work, Assessment of maintenance work. Performance and productivity measurement; problem solving techniques. Statistical processes. Parato chart. Man power planning and training for maintenance and safety staff.

UNIT II: Plant Facilities and Layout Planning

Basic Plant facilities, (a) Building: Types of Building structures, Ventilation and lighting, Roads and parking. (b) Electrical power generation, distributions, utilization, stand by units. (c) Heating, ventilation and Air

conditioning. (d) Water supply, Purification, use and disposal. (e) Sanitation. (f) Planning and estimation of auxiliary services, such as water, steam, compressed air.

Layout of facilities-Types of layouts, selection of layout.Group technology aspect. P. Q. Analysis, PQRST analysis, material flow, REL charts, space requirements, space diagram. Use of computer for optimization of layouts.

UNIT III: Maintenance Management Practice

Various types of maintenance, breakdown, preventive, periodic or predictive, condition based maintenance as predictive preventive maintenance. Online or off-line, concept of health as well as usage monitoring. Quantitative decision making for selection of maintenance system & management classification of material, MICLASS, CUSDD, Software for Classification and Coding. Maintenance problems occurring in product and process type industries and Power plants and their management.

Spare Parts Management- Simulation and Software needed for spare parts management and inventory planning.

UNIT IV; Preventive Maintenance and Life Cycle Costing

Periodic Preventive Management - Scheduled maintenance and period for P.M. Life cycle cost taking into consideration maintenance, reliability, hazard function etc. Life cycle costing: Rigorous models, mathematical formulation etc.

UNIT V: Plant Safety issues and Energy conservation

Plant safety-fire protection and prevention, safety against mechanical hazards, chemical hazards, accident prevention practices and codes. Pollution control-Waste disposal, existing limiting norms. Recycling of waste. Energy conservation, management and audit. Material handling equipment's.

UNIT VI: Advanced topics in Maintenance Engineering

Condition based maintenance, using Vibration Signature, SOAP, ferrography, hot ferrography, Infra Red Camera, fluorescent dye, Particle Analyzers and other diagnostic techniques. Reliability Centered Maintenance.

Total Productive Maintenance: Organization, merits and demerits, Terotechnology and its influence on plant engineering and maintenance, specific application areas, Overall effectiveness of equipment (OEE). RAM analysis: Inherent Availability, Operational Availability, etc.

Text Books:

1. A. K. Gupta,"*Terotechnology& Reliability Engineering* ",McMillan Co.
2. SushikumarSrivastava,"*Industrial Maintenance Management* ",S.Chand and Co.Ltd., New Delhi.
3. R.C. Rosaler-Handbook of Plant Engineering-McGraw Hill.ISBN 0070521646

Reference books:

1. B.Bhadury and S.K. Basu, "*Terotechnology: Reliability Engineering and Maintenance Management* ",Asian Books, New Delhi 2002.

2. A. K. S. Jardine, "*Maintenance, Replacement & Reliability*" HMSO, London.
3. R.A. Collacatt,"*Mechanical fault Diagnosis and Condition Monitoring*",Chapman and Hall Ltd.ISBN 0412129302
4. Higgin-Handbook of Maintenance Engineering- McGraw Hill.
5. Rudenko-Material, Handling equipment-MIR:- Publication.
6. Jacob Fruchlboum-Bulk Material Handling, Handbook; CBS Publisher & distributor, ISBN 8123905416
7. H.P. Garg -Industrial Maintenance, S. Chand and Co. New Delhi, ISBN8121901685
8. Edward Srivastava-Maintenance Management.

411134 (c): ELECTIVE III : INDUSTRIAL RELATIONS & HUMAN RESOURCE MANAGEMENT

Teaching Scheme	Credit Scheme	Examination Scheme
Self Study	Theroy: 04	In-Sem: 30 Marks End-Sem: 70 Marks

Pre-requisites: Production Management

Course Objectives:

1. Study of concept of labour relations, Trade Union
2. Study concept of Human Resource management
3. Study methodology of methodology of manpower requirement - Recruitment and selection process
4. Study of Training Process and Methodology
5. Study of different methods of Performance Appraisal
6. Study of Resignation, Discharge, Dismissal, Suspension, Retirement, Layoff, Voluntary

Course Outcomes :

1. Student will be able to apply concept of labour relations, Trade Union
2. Students will be able to apply concept Human Resource management
3. Students will be Able to describe methodology of manpower requirement - Recruitment and selection process
4. Student will illustrate Training Process and Methodology
5. Students will elaborate Ethics and Concepts of Performance Management - Different methods of Performance Appraisal
6. Students will be able to apply concept of Resignation, Discharge, Dismissal, Suspension, Retirement, Layoff, Voluntary

Unit I:Industrial Relations

Status labour relations, cause and effects of strained relations, organized labour and Trade Union ,History of Indian Trade Union movement , Role of Trade Union, Responsibilities and functions of trade unions, Collective bargaining, its effects on industrial relations, Financial and non financial incentives for improving industrial relations.

UnitII: Human Resources

Management - Introduction and Importance - Evolution - Difference between Personnel Management and HRM - Role of HR Manager - Structure of HR Department - Duties and responsibilities of HR Manager

HRD Systems

Evolution - Goals - Elements and their interrelationship - HR Strategies - HR Strategies and Organizational Strategies.

Unit III: Manpower Planning

Objectives - Estimating manpower requirement - Recruitment and selection process – Main resources of recruitment - Assessment Devices - Retention of manpower – Succession Planning

Merit Rating:

Promotions - Transfers - Job Description - Job Evaluation - Job Enlargement – Job Enrichment - Job Rotation

Unit IV: Training and Development

Training Process and Methodology - Need and objectives - Training Procedure - Methods of Training - Tools and Aids - Evaluation of Training Programmes

Unit V: Performance Appraisal Management System

Definition, Ethics and Concepts of Performance Management - Different methods of Performance Appraisal - Rating Errors

UnitVI: Retirement / Separation

Kinds of Retirement - Resignation, Discharge, Dismissal, Suspension, Retirement, Layoff, Voluntary Retirement / Separation Schemes, Golden handshake. Role of HRD in developing Industrial Relations - Concept - Industrial Democracy - Industrial Peace

Text Books:

1. Garry Dessler, "*Human Resource Management*,Pearson", ISBN8131725383

2. R.S.Dwiwedi ,Managing Human Resources .

Reference books:

1. C.B.Mamoria ,"*Personnel Management"*, ISBN5000000055
2. B.P.Michael, Human Resource Management .
3. Dr.P.C.Pardeshi Human Resource Management .
4. Mirza &Saiyadin," *Human Resources Management*", Tata McGraw Hill Company.
5. ArunMonappa ,Managing Human Resources .

411134 (d): ELECTIVE III: MARKETING MANAGEMENT

Teaching Scheme	Credit Scheme	Examination Scheme
Self study	Theroy: 04	In-Sem: 30+70 Marks

Pre-requisites: Production and Industrial management – I & II

Course Objectives:

1. To introduce the students to broad perspective of marketing philosophy of business .
2. To know the students consumer behavior .
3. To know the students process of gathering marketing information.
4. To know the students organization of marketing process for new product.
5. To know the students concepts of sales management.
6. To know the students basic market research process.

Outcomes:

1. Be able to understand marketing philosophy .
2. Student able to understand consumers buying behavior .
3. Be able to do the market segmentation for a particular product.
4. Be able to develop market for new product.
5. Be able to understand professional and ethical responsibility of sales force.
6. Be able to conduct market research through questioner techniques.

Unit I: Introduction to Marketing Management

Marketing philosophy of business, an industrial marketing perspective, Understanding and monitoring the environment

Unit II: Customer Behavior

Understanding consumer's decision processes, analyzing Consumer Behavior, perspectives of organizational buyers in industrial markets

Unit III: Market Segmentation

Gathering marketing information, segmenting markets and positioning products, formulating marketing strategies, planning marketing programmes, managing products

Unit IV: Marketing Organization for New Product

Developing new products, marketing intermediaries, managing market logistics, Price theories, Establishing and managing prices, designing and managing product promotions

Unit V: Sales Management

Managing sales force and sales territories, Services marketing, marketing and technological innovations, Non-profit and social marketing

Unit VI: Market Research

Marketing research and its importance, scope, structure and methods, role of quantitative techniques and tools in marketing research

Text Books:

1. Philip Kotler ,"*Marketing Management* ",Prentice Hall, ISBN0130122173

2. V.S.Ramaswamy and S.Namakumari,"*Marketing Management,Macmillan*", ISBN0333937198

3. Lilien& Kotler &Moorthy," *Marketing Models*",Prentice Hall, ISBN8120314751

Reference books:

1. W.J. Stanton," *Fundamentals of Marketing"*, McGraw Hill 1998

2. Philip Kotler and Gary Armstrong, Principles of Marketing 9th Edition -

3. Bovee and John Thill, Marketing

4. R.Srinivas ,"*Case Studies in Marketing - Indian context",*4th Edition Phi Learninng, ISBN8120335430

411135: ELECTIVE III: LAB

Teaching Scheme	Credit Scheme	Examination Scheme
Self Study	TW: 01	Term Work:50 Marks

Term Work:
Any six assignments based on the respective Elective III syllabus (One from each unit)